

ON THE OCCURRENCE OF *BEEKITE* IN CONNECTION WITH
 "FOSSIL ORGANIC REMAINS," IN N. S. WALES.

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[Plate XVI.]

Among the many mineral substances replacing the original carbonate of lime composing what are generally known under the name of "fossils," are iron-pyrites, iron-oxide, sulphur, malachite, magnesite, talc, and silica of various forms, such as *Beekite*, chalcedony, and both common and precious opal. "By far the commonest mode of replacement is that whereby an originally calcareous skeleton is replaced by silica. This process of 'silicification'—of the replacement of *lime* by *silica*—is not only an extremely common one, but is also a readily intelligible one; since carbonate of lime is an easily and flint a hardly soluble substance. It is thus easy to understand that originally calcareous fossils, such as the shells of Mollusca, or the skeletons of Corals, should have in many cases suffered this change, long after their burial in the rock, their carbonate of lime being dissolved away, particle by particle, and replaced by precipitated silica, as they were subjected to percolation by heated or alkaline waters holding silica in solution."*

"In a large number of cases of silicification," continues Prof. Nicholson, "the minute *structure* of the fossil which has been subjected to this change is found to have been more or less injuriously affected, and may be altogether destroyed, even though the *form* of the fossil be perfectly preserved. This is the rule where the silicification has been secondary and has taken place at some period long posterior to the original entombment of the fossil in the enveloping rock; whereas if the original fossilisation has been effected by infiltration with silica in the first instance, then the minute structure is usually perfectly preserved. In secondary silicification, as seen in corals and shells, the carbonate of lime of the original fossil is gradually more or less completely replaced by silica, the process beginning on the exterior and gradually extending inwards."†

In New South Wales we are at present acquainted with three methods of replacement of carbonate of lime—by iron-pyrites,

* H. A. Nicholson, *Man. Pal.*, 3rd Edit., 1889, I., p. 7.

† *Loc. cit.*, p. 7.

common and precious opal, and "orbicular silica" or *Beekite*. We have in the Collection a valve of a Tertiary Pelecypod from Port Fairy, in Victoria, completely converted into iron-pyrites; the Collection of the Department of Mines possesses some excellent specimens of conversion into the two opals from the Western Opal-fields; whilst in the present communication it is intended to deal with certain corals, showing the entire structure replaced by orbicular silica, or *Beekite*, a mineral not recorded in Prof. A. Liversidge's 'Minerals of New South Wales.'*

Beekite, strictly speaking, is not a true mineral species, but a chalcedonic variety of silica, replacing the carbonate of lime of fossil organic remains by secondary silicification. Bristow,† who gives the best description, says that in the New Red Conglomerate of Devonshire (Eng.), it occurs as rounded masses from half to one inch, but sometimes from three to six inches. The surface consists of chalcedony arranged in tubercles from the size of a pin's head to that of a pea, each of which is surrounded by one or more rings, producing a more or less rosette-like appearance. Amongst other localities, Bristow incidentally mentions its occurrence in India, and "in Australia, in Triassic Conglomerates," but I am not acquainted with the source of his information as to the last-named occurrence.

I have met with *Beekite* on a *Strophalosia* from the Permo-Carboniferous of Bingera, Co. Murchison, in the Department of Mines Collection, and plentifully on Siluro-Devonian Corals in the black limestone of Cave Flat, Murrumbidgee. If my memory does not deceive me, there are also traces of the mineral on the chalcedonically replaced Brachiopoda from the Permo-Carboniferous rocks of Point Puer, Tasmania, in the Natural History Museum, London.

Prof. A. H. Church,‡ who has to a certain extent artificially simulated *Beekite* in the Laboratory, speaks of it as "a curious silicified substance, at once a mineral and a fossil," presenting itself under such a variety of aspects as to baffle description, so far as regards its physical features. Its chemical composition, however, is more constant, the original constituents having become "so modified in constitution as to contain on an average no less than 92 per cent. of silica," a small but variable quantity of lime remaining, but more in the form of silicate than carbonate. Prof. Church's theory, expressed in his own words,§ is "that water charged with carbonic acid and silica removed the carbonate

* The Minerals of New South Wales, etc., with map. (8vo. London, 1888).

† Glossary of Mineralogy, 1861, p. 39.

‡ Journ. Chem. Soc., 1861, XV., p. 109.

§ Journ. Chem. Soc., 1863, XVI., p. 31.

of calcium from corals, shells, etc., and deposited silica in its room, a portion of the calcium compound also being rearranged and re-precipitated."

With the view of showing the size obtained by a single rosette, Prof. Church figures three costæ and intermediate furrows of an ordinary-sized *Pecten*, over which it had spread.

The best examples of *Beekite* in our Collection are a very large *Syringopora* from the Siluro-Devonian Limestone of Cave Flat, and a *Heliolites* from the Wellington Caves. In the former case the whole of the corallite walls are converted into a granular chalcedonic quartz arranged more or less in lines, where the surface is not occupied by the *Beekite* rosettes, which are usually contiguous to one another and touching. Each rosette consists of a central nucleus, surrounded by concentric rings, which seem to slightly imbricate at their edges. As a rule there are two or three rings, but any number may occur up to eight. Here and there, two nuclei with their rings are surrounded or enfolded in larger and outer rings, forming, as it were, double rosettes. The rings are not always continuous, but broken up into circlets of granules; and the more numerous the circles are, the finer and closer together they become. In a few cases the rosettes appear to have been so rapidly developed as to have become more or less confluent, whereby the regularity of form is in a measure lost. The concentric structure extends through the whole thickness of the corallite walls.

In the *Heliolites* two conditions are apparent. In the first, the entire surface of the corallum, including both autopores and siphonopores, is converted into a series of large rosettes, obliterating totally the two orders of polygonal corallites. In the second case the autopores remain as more or less rounded openings, the siphonoporal ("cœnenchymal") surface being occupied by the rosettes, this being a species of *Heliolites* in which the siphonopores are largely developed.

Two well-marked instances of *Beekite* silicification may be cited for comparison. Prof. James Hall has figured* a *Fenestella* from the Upper Helderberg Formation of New York State, in which the whole of the polyzoarium, both interstices and dissepiments, is converted in this way. Another case is that of Dr. F. Toula's figure† of *Spirifer striato-paradoxus*, Toula, from the Carboniferous Limestone of Spitzbergen, in which the rosettes are in some respects even better marked than in our specimens.

* Ann. Report State Geologist of New York for 1882 [1883], No. 2, t. xxxv. (28), f. 18.

† Sitz. K. K. Acad. Wissensch. (Math. Nat. Cl.), Wien, LXVIII., Abth. 1, t. 1, f. 2a.